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SCIENCE

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FRIDAY, OCTOBER 18, 1918

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WOODROW WILSON

SCIENCE

FRIDAY, OCTOBER 18, 1918

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THE AMERICAN CHEMIST IN WARFARE[1]

IT was the fortune of the writer in the latter part of 1916, a few months before the United States entered the war, to be sent by the Ordnance Department to study in England, France, Italy, Norway and Sweden certain chemical processes, particularly those having to do with the fixation of nitrogen.

On this trip many chemical plants were visited. In all of them the same story was told of depleted chemical personnel owing to the loss of chemists in the trenches and the consequent handicap under which all these plants were laboring in their attempts to furnish the armies with the sinews of war. The whole munitions program had been retarded owing to lack of technical men, chiefly chemists, and the statement was everywhere made that the greatest mistake that the Entente countries had made had been in giving too little attention to brain power and too much to physical strength. On the other hand, it was pointed out that Germany had carefully conserved her chemists for the development of the new and terrible forms of warfare she was forcing on mankind. Science was being used as it had never been used before, to aid a relentless power, and the only means of combating the new form of warfare was with its own weapons.

Already France, England, Italy and Canada had withdrawn all chemists remaining in the service for chemical duty at home, but many had already been lost and their loss was seriously felt. France had drawn so far as possible on the chemists and engineers of Norway, and England drew on her colonies. Indeed, the chemist who perhaps more than any other in England is responsible for the success

[1] Presented at the fifty-sixth meeting of the American Chemical Society, Cleveland, September 10, 1918.

of England's munitions program is an American; and several English chemists who were living in America returned to England for chemical duty.

With this example in mind, the director of the Bureau of Mines and the Secretary of the American Chemical Society called on the Director of the Council of National Defense, and after consulting with him, at his official request, undertook to obtain a census of American chemists for use in the war that was already imminent. This census was started in February 1917, and has been kept up uninterruptedly to the present time. By July, 1917, some 15,000 chemists had sent in full data as to their address, age, place of birth, lineage, citizenship, dependents, institutions from which graduated, chemical experience, experience in foreign countries, affiliations with technical societies, military training, publications, research work performed, and other data of importance. The list has been continually added to, questionnaires being sent to every new name of a chemist that could be obtained. While the list is not complete, owing to the fact that some chemists, no matter how carefully followed up, will not reply to letters, nevertheless, the data are comprehensive and as complete as they can be made.

The cooperation between the Bureau of Mines and the American Chemical Society was perfect. The bureau furnished its whole statistical force and the society put special clerks at work. The data obtained were indexed and cross-indexed on some 28,000 cards. When America entered the war every chemist was directed to keep the society informed as to his military status, and continual correspondence was carried on by the society direct with officers and privates in order that the chemists of the country might serve the country in the best possible manner. To-day the list consists of some 17,000 filled-out questionnaires, 12,020 membership cards of the American Chemical Society, and some 3,000 cards of *bona fide* chemists actually in war service, most of them in uniform. A card list is kept of officers and enlisted men who are graduate chemists in the United States Army in America; another list of those in France, including both those in chemical service and in the Army and expeditionary forces not yet transferred to chemical service, and another list of those in the Navy. It is believed these lists are reasonably complete and up to date.

This work has involved an expenditure of many thousands of dollars, the writing of over 10,000 personal letters, and the sending of over 50,000 circular communications to the chemists of the country.

Already in the early part of February, 1917, the president of the American Chemical Society, Dr. Julius Stieglitz, had offered without reservation the services of the members of the American Chemical Society to President Wilson in any emergency that might arise and had received an appreciative reply. On February 15, 1917, a similar communication was addressed, by direction of the president, by the secretary of the society to the Secretary of War; and on April 11, 1917, at the Kansas City meeting of the American Chemical Society, the following resolutions were passed, which were widely circulated, and had a profound effect on the mental attitude of American chemists:

Resolved, That we reaffirm the tender to the President of the United States of the services of the members of our society in all the fields in which we are qualified to act.

That the security and welfare of the country demand the organization of all the men and facilities of the United States, so as to insure the greatest possible service and value for each.

The progress of the war thus far principally teaches us that modern warfare makes extraordinary demands upon science, food supply and finance.

For the protection and success of our men under arms we recommend the use, in their respective fields, of all trained chemists, physicists and medical men, including advanced students of these subjects.

To this end, in collaboration with the United States Bureau of Mines, we are preparing a census of chemists. With no desire to avoid field service for men of training in the professions named, we urge that those of special ability be held to the work they can best perform. Thus we may avoid

unnecessary loss from lack of control of the tools and requirements of war.

We hold that the use of platinum at this time in the production of articles of ornament is contrary to public welfare. Therefore, we recommend that an appeal be made to the women of the United States to discourage the use of platinum in jewelry and that all citizens be urged to avoid its use for jewelry, for photographic paper and for any purpose whatever save in scientific research and in the making of articles for industrial need.

A committee consisting of Dr. W. H. Nichols, Dr. M. T. Bogert, Dr. A. A. Noyes, Dr. Julius Stieglitz and Dr. C. L. Parsons had, in June, 1917, drawn up and presented a report on "War Service of Chemists" and "A Plan for the Impressment of Chemists and for the Preservation of the Supply of Chemists." Several important editorials by Dr. Chas. H. Herty and communications to the chemists of the country advising them as to their procedure had appeared in *The Journal of Industrial and Engineering Chemistry*.

That the wisdom of carefully listing the chemists of the country more than warranted the expenditure and effort has been apparent from the first. The war had scarcely begun when the growth of the ordnance and other departments developed a tremendous demand for chemists, first to obtain chemical information from the other side, and soon to develop information on this side. A large part of the chemists now in war work were obtained and classified from this list. The officers of the Bureau of Mines and of the American Chemical Society were the scene of continual conferences regarding chemical personnel and the development of chemical warfare. Practically all of the chemists who early entered the Ordnance Department in a commissioned capacity were either obtained through the American Chemical Society or passed upon by its officers. When the Bureau of Mines began its investigation on gas warfare the list was invaluable, and representatives from practically all of the bureaus and departments in Washington consulted it from time to time as their needs increased.

When the chemists were later drafted into the Army this census served as a basis for determining their qualifications, which later, through the far-sighted assistance of Assistant Secretary Crowell, resulted in chemists being withheld for chemical service.

From the first the chemical personnel of the Army and Navy and the civilian bureaus was partly civilian and partly military. As the war progressed the proportion of chemists in uniform naturally increased as the men were taken from the Army and assigned to chemical duty. The question is still a disputed one—to be settled probably only when the war is over—as to whether a chemist can serve best in a civilian or a military capacity. Certainly in both capacities the demand for chemists has been unprecedented and the development of chemistry in modern warfare to those in touch with the advancement made seems almost a fairy tale.

The first requirement for chemists in quantity in Washington was in connection with gas work organized by Director Van. H. Manning and carried on by the Bureau of Mines with its own funds until July, 1917, after which, steadily increasing funds were furnished to it by the Army and Navy. The gas research work was located at the Bureau of Mines Experiment Station some four miles from the center of the city of Washington.

A branch laboratory of the Bureau of Mines was also established at the Catholic University, Washington, and other branch laboratories and cooperative research work carried on at such institutions as Johns Hopkins, Harvard, Yale, Princeton, Ohio State, Wisconsin, Washington, Kansas, Michigan, Columbia, Cornell, California, Rice Institute, Iowa State College, Bryn Mawr, Massachusetts Institute of Technology, Worcester Polytechnic, etc. Also special problems were undertaken by the National Carbon Company and the National Electric Lamp Association, as well as by chemists and laboratories of many of our other important chemical corporations.

One of the most interesting features of this work was the spirit shown by American chemists and the immediate response made by practically every chemist in America to the call to duty. The organization was rapidly built up

and contained the names of the most prominent chemists in the country, as well as those of hundreds of young chemists who will later become prominent.

When this organization was taken over by the Chemical Warfare Service in June, 1918, there were over 700 chemists at work on problems having to do with gas warfare, the design of gas masks, protection against toxic gases, development of new gases and the working out of processes for those already used, the details of incendiary bombs, smoke funnels, smoke screens, smoke grenades, colored rockets, gas projectors and flame throwers, thermal methods for combating gas poison, gases for balloons and other materials directly or indirectly connected with gas warfare.

This body of chemists reporting to Colonel G. A. Burrell had nearly 1,100 helpers in the way of clerical force, electricians, glass blowers, engineers, mechanics, photographers and laborers, so that when it became a part of the Chemical Warfare Service some 1,800 persons were transferred, of whom over 700 were chemists—among them the leaders of the profession. At the same time the gas defense operations of the Medical Department under Colonel Bradley Dewey, consisting chiefly of the large scale manufacture of gas masks and gas mask chemicals, the gas offense proving grounds under Major William S. Bacon, and the gas defense training under Major J. H. Walton were also transferred to the new Chemical Warfare Service. The story has been told in detail in the September number of *The Journal of Industrial and Engineering Chemistry* and need not be repeated here.

Shortly after this work of the Bureau of Mines was begun the development of the Ordnance and Medical Department created an additional demand for chemists. The chief of the Trench Warfare Section, Lieutenant Colonel E. J. W. Ragsdale, early called for chemists to go to England and France in a commissioned capacity to obtain necessary information. Soon other chemists were required for the planning and building of gas plants and the manufacture of chemicals. The Trench Warfare Section continued this work in greatly increasing personnel until the early part of 1918, when the chief of the newly formed Chemical Service Section was transferred to the Ordnance Department and given charge of the production of chemicals for gas warfare. A new arsenal known as Edgewood Arsenal was established for this purpose. Hundreds of chemists and engineers were employed, and the arsenal had become almost a city in size, with enormous plants ready for operation, when it too was transferred from Ordnance to the newly organized Chemical Warfare Service, in June, 1918.

It was a real epoch in the history of chemistry in warfare when, as a result of conferences held at the Bureau of Mines with officers from the Medical Corps, War College, General Staff, Navy and civilian chemists, the Chemical Service Section was established as a unit of the National Army, with Lieutenant Colonel Wm. H. Walker, formerly of Massachusetts Institute of Technology, as chief of the American branch reporting to Colonel Potter of the Gas Warfare Division, and Lieutenant Colonel R. F. Bacon as chief of the Chemical Service Section in France reporting to Colonel A. A. Fries, head of the Gas Warfare Division overseas.

This was the first recognition of chemistry as a separate branch of the military service in any country or any war.

Later, Colonel Walker, as before stated, was transferred to the Ordnance Department, and was replaced by Lieutenant Colonel M. T. Bogert. The latter was in charge of the American branch of the Chemical Service Section at the time this section, together with all of the gas research laboratories and personnel of the Bureau of Mines, and the plant and field operations of the Ordnance and Medical Department pertaining to gas warfare, were united under Major General William Sibert, under the new title of Chemical Warfare Service.

It can not be brought out too strongly that the Chemical Service Section of the National Army was the first organized military body established for the sole purpose of relating chemistry to warfare. It took as an insignia

the old alembic of alchemy joined with the theoretical benzene ring which has so greatly accelerated the development of modern chemistry. It further adopted for its colors those of the American Chemical Society—cobalt-blue and gold.

The Chemical Service Section was of very great service, especially in systematizing the regulations of the War Department in regard to chemical personnel, and the status of chemists was ably defined through its influence, in the order of May 28, 1918. On account of its historical importance this order is quoted here.

1. Owing to the needs of the military service for a great many men trained in chemistry, it is considered most important that all enlisted men who are graduate chemists should be assigned to duty where their special knowledge and training can be fully utilized.

2. Enlisted chemists now in divisions serving in this country have been ordered transferred to the nearest depot brigade.

3. You will make careful inquiry into the number of graduate chemists now on duty in your command and report their names to this office. The report will include a statement as to their special qualifications for a particular class of chemical work, and whether they are now employed on chemical duties.

4. Enlisted graduate chemists now in depot brigades, or hereafter received by them, will be assigned to organizations or services by instructions issued from this office. The report called for in paragraph 3 herein will be submitted whenever men having qualifications for chemical duties are received by depot brigades, or replacement training camps, or by the training camps organized by the various staff corps.

5. Enlisted men who are graduate chemists will not be sent overseas, unless they are to be employed on chemical duties. Prior to the departure of their organization for overseas duties, they will be transferred to the nearest detachment or organization of their particular corps.

6. The chief of the Chemical Service Section will be charged with the duty of listing all American graduate chemists, including those in the Army and those in civil life.

7. Whenever chemists are needed by one of the bureaus or staff corps, request will be made on the chief of the Chemical Service Section for recommendations of a man having the qualifications necessary for the particular class of work for which he is desired. If men having chemical qualifications are wanted for only a short period of duty, they will be temporarily attached to the bureau or staff corps; where the duty is of a permanent nature, instructions covering their transfer will be issued. Whenever the chemists, thus attached or transferred, are no longer needed for purely chemical duties, a report will be made to the chief of the Chemical Service Section in order that they may be assigned to chemical duties at other places.

By order of the Secretary of War,

ROY A. HILL,
Adjutant General

These regulations have since been enlarged so that at present chemists may be furloughed back from the Army to colleges for instruction purposes or to industrial works for essential chemical production. Students may be continued in chemical courses to meet the future need for chemists, and any chemists in the Army may be assigned to war work wherever needed. All this has been done not for the sake of the chemists, but on account of the scarcity of trained chemists and the great need of the country for their services as chemists to help win the war. Without chemistry to-day the continuation of the war would be impossible.

A summary, necessarily brief, of the departments and bureaus utilizing chemists may be taken up in the following order:

I. ARMY

A. General Staff

Executive Division, Chemical Warfare Service.—This branch of the service established by General Order No. 62, already published in the chemical journals, is in command of Major General William Sibert, of the engineers. It has, according to the order above referred to, full charge of all phases of gas warfare, including research, manufacture, shell filling plants and proving grounds. It also continued the functions of the Chemical Service Section with increased authority.

All newly drafted chemists are assigned to the Chemical Warfare Service to be detailed or transferred or furloughed where needed. It is charged with the "responsibility

of providing chemists for all branches of the government and assisting in the procuring of chemists for industries essential to the success of the war and government."

It has an authorized personnel of 45,000, of which any portion may be chemists if needed. At present there are approximately 1,400 graduate chemists in the Chemical Warfare Service.

B. Ordnance Department

(*a*) *Engineering Division, Explosive Section.*—Under the direction of Colonel J. P. Harris, this division has ten commissioned and six civilian chemists. This section concerns itself with the solution of all engineering problems connected with propellants, the loading of high explosives into shells, trench warfare containers, primers, the research in high explosives, the investigation of explosives submitted for testing, efficiency of methods of manufacture and the carrying out of tests for developing substitutes.

(*b*) *Procurement Division, Raw Materials Section.*—The Chemical Branch of this division under the direction of Major W. H. Gelshenen utilizes the services of five officers whose experience has been chiefly on the commercial side of chemical industry.

(*c*) *Inspection Division, Explosive Section.*—The chemical work of this division is under the direction of Major Geo. B. Frankforter, who has a personnel of somewhat more than 1,000 chemists under his direction. Major Moses Gomberg is supervisor of special process work. The chemists are divided into three grades—"inspectors" who are responsible for all powders meeting specifications; "analytical chemists" who analyze and test all powders and report results to inspectors; "linemen" who are control chemists having charge of certain steps in the process of manufacture.

These chemists are employed throughout the United States at explosive plants, chiefly inspecting processes of manufacture and the finished product. The section maintains an officers' training school at Carney's Point for training for inspection, testing and process control of explosives. Graduates of the school are, in a few instances, commissioned; otherwise they are retained in a civilian capacity. There is a tendency to place all men in uniform as rapidly as possible. There has been such a demand for chemists that most of them have not finished the training before being given experience in the plants, so that they are obtaining their training and experience at the same time, with the expectation of returning to the school for more theoretical work before graduation.

The school at present has 150 chemists taking training with from six to ten instructors. The training consists of an extensive review of organic and inorganic chemistry, chemical engineering, including mechanics and plant operations; also a review of physics and a special study of the chemistry of explosives both in the laboratory and in the plant. The school has good laboratory facilities and a school day of ten hours. Civilians who are taken into the school are paid at the rate of $1,500 to $2,000 from the time they enter.

Recently a supervisory and control laboratory with 20 chemists has been established in Philadelphia for the purpose of making control analyses and investigating certain problems having to do with the inspection of explosives.

(*d*) *Inspection Division, Metallurgical Section.*—This division employs 79 chemists, 23 being in uniform. The work is in charge of Major A. E. White, and laboratories are maintained at 25 of the leading steel plants of the country, with the central control laboratories in the buildings of the Bureau of Mines at Pittsburgh. Also, two chemists are working in the laboratories of the Bureau of Standards for this branch of the service. With the exception of the central control laboratory and the work at standards, the work of this section consists chiefly of the analyses and control of ferrous products.

(*e*) *Production Division: (1) Explosive Section; (2) Raw Materials Section.*—This work is under the direction of Major E. Moxham, with Major C. F. Backus in charge of the Explosives Section and Major M. S. Falk in charge of the Raw Materials Section. The section numbers among its personnel 18 chem-

ists or chemical engineers engaged in executive and administrative work on the production of smokeless powder and high explosives. The section has no laboratory facilities, the work accomplished being chiefly in facilitating increased production through specializing in the various works on manufacturing problems.

The division has been concerned with the investigation of new processes for the production of raw materials, some of which have been put into operation, especially the production of toluene by the cracking of petroleum. The Raw Materials Section arranges for the production and distribution of raw materials, such as nitric acid, sulfuric acid, benzene, phenol, ammonia and sodium nitrate. Besides investigating new processes, the section studies increased production and distribution of supplies. For the main part the chemical personnel is on duty at various plants investigating production and processes.

(*f*) *Nitrate Division.*—Colonel J. W. Joyes is in charge of this Division, with Lieutenant Colonel A. H. White in charge of the Research Technical Section. The Nitrate Division was organized shortly after war began with the special duty of installing plants for the fixation of air nitrogen. It now has a personnel of 130 chemists and chemical engineers, enlisted and commissioned. It has only a few civilian chemists in its employ. It has cooperated with and received help from the laboratories of the Massachusetts Institute of Technology, the Geophysical Laboratory, the University of Michigan, the Bureau of Soils (Arlington), the Bureau of Standards and the Bureau of Mines. It has built extensive works at Sheffield, Ala. It has a small experimental plant at the Georgetown Gas Works, and another at Greene, R. I. In cooperation with the Bureau of Mines, it carried on experiments on ammonia oxidation at Syracuse, N. Y., and at Warner's, N. J. The division is one of the most important from the chemical development standpoint that has been established for war purposes. It has very large appropriations at its disposal and it has two nitrate plants in Ohio in preliminary stages of erection. It contemplates other activities in nitrogen fixation.

The Ordnance Department also runs four arsenals—Picatinny, Watertown, Frankford and Rock Island—in all of which chemists are regularly employed. The number of chemists in the arsenals has been largely increased since the war began. No figures are at the moment available.

C. Quartermaster's Corps

The chemical work of the Quartermaster's Corps involves the testing and analyses of materials, foods, leather, paper, etc., the making of specifications, and the control of materials to find if the specifications are complied with. The corps has few chemists in uniform, as the work has been done chiefly in the laboratories of the Bureau of Chemistry.

The filtration plants at the various government camps and cantonments are also under the control and direction of the Quartermaster General.

D. Surgeon General's Office

Food and Nutrition Division, Medical Department, Sanitary Corps.—This division has 91 food and biological chemists who are in uniform. In each camp there is stationed one nutrition officer who is preferably a food expert with as much physiological, biological and sanitary training as possible. His duty is to inspect all food, mess halls, refrigerators, etc., with the object of maintaing a high degree of sanitation. He has full authority to see to it that meat, for example, is destroyed if dropped upon the ground in hook worm territory; also any other food that could in any way injure the health of the men. There are three survey parties in the Sanitary Corps whose duties consist in going from camp to camp, getting information regarding garbage and collecting data on nutrition problems. This is put in the form of curves in the Washington office. The work is part of an extensive nutritional study and is expected to give important results for future use as well as for present Army needs.

Research, with reference to the physical

properties of various proteins, creatin, etc., is being carried on for the corps in the laboratory at Cambridge under Dr. Henderson. Research relative to rope disease in bread, catalytic action in relation to yeast activity, etc., is progressing, from which valuable results are already in sight. At the Harriman Research Laboratory the special problem is meat spoilage. It is hoped it will be possible to detect incipient spoilage by chemical means. At the Bureau of Chemistry, Department of Agriculture, members of the Sanitary Corps are working on garbage research and making a survey of all food furnished to the various camps. An examination is made of all garbage cans in order to determine how much of the food finds its way into the stomachs of the men. This has resulted in a great saving of food material.

At the University of Rochester investigations have been made as to the effect of temperature in desiccated vegetables, as it is thought high temperatures used in desiccation may tend to induce certain diseases, such as scurvy, pellagra, beri beri, etc. A safe temperature is being studied. Independent investigations bearing upon the work of the Sanitary Corps are being carried out in the Bureau of Chemistry.

The Sanitary Corps maintains a school for the training of nutrition officers at Fort Oglethorpe, in connection with the Medical Officers' Training School. Men sent to this school are selected from the standpoint of training and experience in food and nutrition work, together with biological training. Frequently the men are commissioned before entering the school, if they have had sufficient training, although in certain instances privates have entered the school and ben granted commissions later.

E. Aircraft Production

This Bureau now requires the services of 51 chemists in two sections. There is the Section of Chemical Research under Dr. H. D. Gibbs, who has 18 chemists (13 in uniform) engaged specifically in research problems, plant operations, study of new materials, chemical processes, methods of making new chemicals required in airplane construction, etc. Interesting studies are also being conducted on certain photographic sensitizing dyes to be used in airplane photography. This Bureau also maintains in Pittsburgh an inspection and control laboratory employing 33 chemists, 5 in uniform and 28 civilians. This laboratory has 60 technical men, of whom 30 are chemists. These chemists were afforded space in the Bureau of Standards until April 1, when they were removed to the home of the Pittsburgh Testing Laboratories, Pittsburgh, Pa. The work is in charge of Dr. H. T. Beans. The laboratory has general control of all products purchased by the Aircraft Production Board; it develops specifications for new materials and sends chemists into the plants to get the grades of materials wanted.

II. NAVY

The Navy also requires chemical aid in warfare, and at the present time has approximately 200 chemists engaged chiefly in control work and plant operation. Each of the navy yards has a control laboratory and the Ordnance Bureau has about 100 chemists, of whom approximately 20 are commissioned, 35 enlisted and 50 civilian. These are utilized in much the same capacity as in the Army Ordnance.

From the first the Navy has immediately transferred to Chemical Service the names of all chemists enlisted in the Navy, where the names and qualifications have been made known to them. While of course the total number is small, the proportionate need has apparently been greater, for there are still several hundred graduate and experienced chemists and chemical engineers, both officers and men, in the Navy, a large proportion of whom have expressed their willingness to serve as chemists if needed, but who are still in the fighting branch or whose duties have no relation to chemical service.

III. CIVILIAN BUREAUS

The Bureau of Chemistry, the Forest Products Laboratory and other bureaus of the Department of Agriculture, the chemical labora-

tories of the Bureau of Mines, Bureau of Standards, and the Treasury Department have all cooperated with their full force in any war problems presented to them. Many of these problems have originated and been carried to a successful conclusion within the bureaus themselves. The civilian personnel of the bureaus has been depleted in almost every instance by the war, but men have been assigned by the War Department to assist in war problems. For example, the Bureau of Standards at present has 70 men in uniform assigned to it from various branches of the government. These are for the main part engaged on studies of new methods of analysis, research on analysis of special materials, analysis of government supplies, and development of airplane dopes, and study of new and improved specifications on government supplies. The studies of electroplating with reference to government needs and the study of the physical characters of alloys have been taken up.

The truly extensive chemical work of the civilian bureaus and their relation to war work will be published in detail at some future time.

IV. COMMITTEE ON CHEMICALS. CHEMICAL ALLIANCE WAR INDUSTRIES BOARD

In the very early days of the war, the Committee on Chemicals, headed by Dr. Wm. H. Nichols, president of our society, and consisting of the leaders of our chemical industries, gave unstinted and invaluable service to the government in coordinating the country's chemical manufacturing resources, in increasing the output of our chemical plants, and in allocating and fixing prices to the government of the finished product.

The value of these services can not be overstated, although comparatively little has been written about them.

When the various war committees of the Council of National Defense were discontinued and their functions absorbed by the War Industries Board, the Chemical Alliance was formed to serve as a clearing house of the chemical manufacturers in their dealings with the government through the War Industries Board. It was organized primarily at the request of the Department of Commerce to assist in clearing up business questions in connection with the importation of pyrite, but later it became a regularly organized trade association, without any official government connection, to which the War Industries Board can turn for expert advice.

Some of the directors at first were original members of the Committee on Chemicals, with Dr. Nichols as president. Later Dr. Nichols retired and Mr. Horace Bowker, vice-president, was made president of the Alliance.

The War Industries Board has been active in the chemical field since its inception. It has well-organized committees to deal with chemical trade matters, especially with the allocating of material, fixing of prices, study of contracts, and a clearing of orders for both the Army and Navy.

V. NATIONAL RESEARCH COUNCIL

The National Research Council early organized a chemistry committee, of which Professor M. T. Bogert was made chairman. When later Professor Bogert was appointed lieutenant colonel in the Chemical Service Section, Dr. John Johnston was put in charge of this work for the National Research Council, and continues in that capacity.

A meeting of prominent chemists takes place in Washington in the rooms of the National Research Council twice weekly, and the conferences serve as a clearing house of research work going on in Washington and in the country. The National Research Council has from the first served as a valuable feeder and intermediary on research between the universities and the government. The council has suggested and cleared many research problems both in this country and abroad.

VI. GEOPHYSICAL LABORATORY

The Geophysical Laboratory, under the direction of Dr. Arthur L. Day, has engaged in important work since the beginning of the war. The developments which this laboratory have made in optical glass are well known and have had an important bearing on the war's progress. The laboratory has been assisting

on the nitrate investigations and other problems. The high standing of its corps of chemists is well known to all members of our society.

VII. THE WAR TRADE BOARD, SHIPPING BOARD, FOOD ADMINISTRATION, TARIFF COMMISSION

These important government departments all require chemists and utilize chemists in a consulting and directing capacity.

The War Trade Board has a member, Dr. Alonzo E. Taylor, who is assisted in passing upon chemical matters by Dr. A. S. Mitchell, Mr. B. M. Hendrix and Dr. R. P. Noble.

The chemical work of the Shipping Board has been under the direction of Dr. W. B. D. Penniman, who, while shutting off the importation of certain products, has helped produce excellent substitutes therefor.

The Food Administration has been guided in chemical matters chiefly by Dr. Alonzo E. Taylor and Mr. Charles W. Merrill.

The chemical work of the Tariff Commission is under the direction of Dr. Grinnell Jones, who this morning gives you a full description of the information being gathered by the Tariff Commission on chemical matters to guide it in its recommendations to Congress, both during and after the war.

Many departments of the government have been in constant communication with our allies on research and industrial chemical matters. Chemical liaison officers have been sent from the Army and Navy and some of the civilian bureaus to keep in touch with foreign development and practise, and their services have been invaluable. In this connection it should be particularly pointed out that not all of the development of chemistry in this country is our own accomplishment, for we have obtained information of the highest importance through the efforts of these liaison officers. On the other hand, chemical information of the highest importance has been sent from America to Europe.

War, the destroyer, has been on the other hand the incentive to marvelous chemical development with a speed of accomplishment incomprehensible in normal times. Discoveries made in the search for instruments of destruction are already in use for the development of chemical industry. Many others, unpublished as yet, and to remain unpublished until the war is over, will prove of the utmost benefit to mankind. The same agencies that add to the horror of war to-day, the same reactions which are used in the development of explosives and poisonous gases, on the one hand, and in counteracting their effects on the other, will find immediate and useful application in the years to come.

The war has been prolonged by chemistry. The German chemist apparently working for years with war in view has supplied the German armies with the means for their ruthless warfare, but the chemists of America and our Allies have met them fully in chemical development, and when the chemical story of the war is written where all can read, it will be the verdict of history that the chemists of America were not found wanting.

The chemical program of the United States Army and Navy has been at all times ahead of our trained man power and the mechanical devices necessary to apply what the chemists of America have produced.

Charles L. Parsons,
Chairman of the Committee on War Service for Chemists

SCIENTIFIC EVENTS

THE CAWTHRON INSTITUTE OF SCIENTIFIC RESEARCH

We learn from the *New Zealand Journal of Science and Technology* that at a meeting of the Cawthron trustees held on May 30, 1918, the appointment of the advisory board was confirmed for six years from the date of their appointment on September 25, 1916. The advisory board consists of Sir James G. Wilson (chairman), Professor W. B. Benham, Dr. L. Cockayne, Professor T. H. Easterfield, Dr. P. Marshall and Professor R. P. Worley.

The advisory board, in conjunction with the chairman of the trustees, is to make inquiries in regard to the appointment of a director, such director to be a chemist with biological

leanings, and to be a man of fair business ability.

It was resolved that the Cawthron trustees approach the government with a view to the appointment of two scientific investigators to operate in the Nelson District with a view to finding out the causes and cures of certain blights; and that the trustees are willing to place at the disposal of the government the sum of £1,000 per annum for a period of two years on condition that any results obtained be the joint property of the government and the Cawthron Institute.

The regulations for the Cawthron Minor Scholarship are now published, and copies may be obtained from Messrs. W. Rout and Sons (Limited), Nelson. Candidates must be British subjects, and the scholar must matriculate at a university college and study for the B.Sc. degree, and sign a declaration that he will, after graduation, accept (if offered) a Cawthron Scholarship of £150 per annum, and pursue his studies for not less than two years at the Cawthron Institute. The Minor Scholarship is of the value of £80 per annum, plus the fees for attendance at university classes up to the amount of £25 per annum. The tenure of the scholarship is for three years. Preference in the selection of a scholar shall be given (*ceteris paribus*) to candidates from Nelson and Marlborough. The scholarship will be awarded on the science papers of the University Scholarship Entrance Examination in not less than two nor more than three of the following subjects: Mathematics, physics, chemistry and botany. The marks obtained, together with a criticism of the work of the first three candidates in each subject, are to be forwarded to the advisory board, which shall then recommend that candidate for election who appears to give the greatest promise of being useful to the institute.

The second annual Cawthron lecture was delivered in the School of Mines, by Professor W. B. Benham, M.A., D.Sc., F.R.S., on May 30. The subject chosen was "Biology in relation to agriculture," and the lecturer devoted particular attention to the problems of fruit-growing and the kinds of research the institute should attempt. These include inquiries into the efficiency of different kinds of sprays on different kinds of trees, the most productive method of pruning, and the most suitable and economic methods of manuring. Other matters that ought to receive attention are: (1) A thorough-going soil survey—the investigation of the chemistry, physics and biology of the soil, and especially of the humus and its effect on plant-growth, of which little is as yet known; (2) an extended program of investigation of the diseases that attack our plants, and especially those that are injurious to the fruit-tree.

The lecture, together with the first annual lecture by Professor T. H. Easterfield, is to be published by the institute.

THE INTERNATIONAL INSTITUTE OF AGRICULTURE AT ROME[1]

THE operations of the institute have been, of course, profoundly affected by the war. At the beginning of hostilities its very existence seemed dubious. As its vice-president, M. Louis-Dop, has pointed out in a recent report reviewing its history and progress, the question was immediately raised as to the possibility of maintaining, in a conflict which has transformed the political and economic conditions of every continent, an organization based upon the collaboration of nations, the working together of a committee representing all the powers, belligerent or neutral, and the efforts of a personnel of international composition. Notwithstanding these obstacles, the continuation of the enterprise was decided upon. Apparently it was felt that the institute had been established as a permanent institution and the suspension of its operations should be avoided if possible. More than this, it was expected that the usefulness of the institute to the world would be in many ways intensified by the war conditions.

The work of the institute has, therefore, been carried on so far as possible. No nation has abrogated the treaty, so that all are full members as before. Meetings of the permanent committees have been held regularly, and each of the bureaus has been performing its func-

[1] From the *Experiment Station Record.*

tions much as in 1914, although crop reports and similar data have been withheld by the Central Powers.

The immediate result of the war upon the institute has been on the whole to increase and stimulate its activities. The need for accurate statistical data regarding the world's food supply has never been so urgent. Information as to improved farm methods and economic measures has been eagerly sought for and with more prospect than ever before of its practical utilization. As regards technical material, particular efforts have been made to render available data as to means of diminishing the impoverishment of the soil, overcoming the shortage of fertilizers and labor, and increasing the use of farm machinery. A special function has been the answering of inquiries regarding agriculture in countries whose own agricultural and statistical departments have been disorganized by the war. It is announced that these various efforts of the institute have met with unusual appreciation from the governing authorities of many nations.

The officers of the institute are also looking forward quite optimistically to the future of the institution after the war. They believe that the return of peace will bring with it vast agricultural problems of international significance, and that during the reconstruction period the institute will have a specially important function to perform. There will be a great demand for accurate information along statistical, economic and technical lines, much of it international in its scope, and for the collection and dissemination of which a central clearing-house, such as this, will have unique possibilities. The institute is already making plans for service in these directions, and more specifically in such projects as the control of locusts, the improvement of the economic status of the farmer, the establishment and development of small holdings, maritime transportation of farm products, the unification of methods for agricultural statistics, farm accounting, control of seed adulteration and concentrated feeding stuffs, and the development of rural sociology.

Despite the unexpectedly difficult problems it has encountered, the institute thus enters upon the second decade of its operations with its organization virtually intact, its publications and other lines of work going on with little interruption, and an ambitious program being formulated for the future.

THE MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA

The University Museum has entered upon an extension of its educational features by the addition of four women to its staff for the purpose of assisting visitors. There will also be an information desk near the entrance door for the accommodation of all comers. Every day, including Sunday, there will be present a professional artist to assist students, professional or designers, who may come to the museum to seek inspiration from its many art and ethnological treasures. A new curator has been employed to assist visitors in examining the collections from Mesopotamia, Greece, Italy and Egypt. The curator of the Oriental Section and the curator of the American Section will be present at all times to assist those who desire to study these exhibits. While the University Museum has always laid stress on its educational features and it has been visited by artists and designers as well as by scholars and the public generally, the management believes the time has arrived when very special efforts should be put forth to make the museum a more integral factor in the commercial as well as the artistic and cultural life of the community. Its new assistants will devote themselves especially to this feature in the particular desire to aid those who are seeking new artistic designs. In explanation of its new work the University Museum makes the following statement:

> It is realized everywhere that this war is to have a profound effect upon the artistic and cultural world. Not only has much of the accumulated artistic beauty of the world been destroyed, but many of the creators of art have lost their lives in the struggle. Reconstruction is not likely to be along the same lines as formerly, for it is certain that there will be new ideals and new inspiration growing out of this war in all countries.

Hitherto the United States has either imported artists or art, or else its people have followed rather slavishly the ideals of Europe. This is especially true in the matter of design as affecting fabrics, textiles, wallpapers, furniture and decoration generally. The University Museum believes that this no longer will be the case. Even the old world nations will branch out on new lines. It would seem as if the greatest nation on earth, that which is raising the greatest army and commercial navy in the world, that which is destined to give the deathblow to the nation which is the foe of all art, the nation which has exceeded all others in invention for the material comforts of mankind, assuredly it seems that such a nation has within itself the power of creative imagination to establish its own school of independent art.

All art harks back more or less to former achievements, but the genius of a nation as of an individual is shown by the original use made of such available material. The University Museum has within its walls collections which have cost millions of dollars and which are valuable for more than their mere objective beauty or cultural qualities. They cover the whole field of civilization from the earliest dawn to the present, and practically every tribe and nation as well as every field of artistic achievement.

It is the belief of the managers of the University Museum that in its rich and rare collections of the art of the past as well as of the primitive races still existing there will be found inspiration and stimulus to aid in developing a truly American art.

Without going into the larger aspects of the situation it can be said that this city which owes so much of its prosperity to manufacture of textiles, furniture, wall-papers and other decorative objects will have a wide field of opportunity before it when the war ends. The nation is building the greatest commercial fleet in the world which it announces is to be used for trade as soon as peace comes. To secure trade this nation and this city must provide the best and most beautiful of commodities or give way to other nations who will supply the demand.

There are thousands of objects in the University Museum ranging from the treasures of ancient Egypt, Crete, Persia, Greece, Italy and South America and the primitives of Oceanica from which inspiration can be drawn with excellent results. It is not presumed that there will be any lavish copying but in this wide range of objects there will be found designs or color schemes which will afford scope to the creative imagination of artists and designers.

WESTERN RESERVE UNIVERSITY MEDICAL GROUP

Two years ago a plot of land which approximated fifteen acres in extent, known as the Ford Estate, was purchased as a site for the new buildings of the Medical Department of Western Reserve University and for a new Lakeside Hospital, for a babies' and for a maternity hospital. It was the plan to create a group of hospital buildings combined with the medical school to make an ideal teaching plant for the teaching of medicine. This tract is situated next to the literary departments of Western Reserve University and the Case School of Applied Science. Although the war has postponed the erection of any of these buildings, Lakeside Hospital lately received some noteworthy contributions and bequests which will materially hasten the building.

By the will of the late Colonel Oliver Payne, a large and generous gift of one million dollars come to Lakeside to be used at the discretion of the trustees. By the will of the late Mr. W. S. Tyler, Cleveland, a trustee of Lakeside, a bequest of two hundred thousand dollars came to Lakeside to be used at the discretion and endowment of a maternity ward on the new site. Mr. Samuel Mather, president of Lakeside, opened the new building fund of the hospital by a gift of three hundred and fifty thousand dollars. There is also a fund held by the trustees of Lakeside for the benefit of the children's and maternity wards amounting to something over one hundred and fifty thousand dollars.

By these gifts the realization of the plans for an ideal teaching group are brought nearer.

THE NEW YORK POST-GRADUATE MEDICAL SCHOOL

SEVEN members of the laboratory staff of the New York Post-graduate Medical School and Hospital are in government service. Ward J. MacNeal, M.D., Ph.D., professor of bacteriology and director of laboratories, is now a major in the Medical Corps and in charge of the Central Laboratory of the Medical Department, France. Richard M. Taylor, M.D., professor of pathology, now a captain in the Medical Corps, is likewise doing laboratory

work in France. Arthur N. Tasker, M.D., lecturer in tropical medicine, a lieutenant colonel in the Medical Corps, is Sanitary Inspector of the Intermediate Section, France. J. Wheeler Smith, M.D., associate in bacteriology, now a lieutenant in the Medical Corps, is doing research work with Colonel Whitmore at the Army Medical School. Anton R. Rose, Ph.D., associate in pathological chemistry, is a captain in the Food Division of the Sanitary Corps. W. L. Aycock, M.D., instructor in bacteriology, a lieutenant in the Medical Corps, is in charge of the laboratory of the U. S. Army Hospital, No. 8 (Post-graduate), France. Arley Munson, M.D., who was appointed instructor in bacteriology in Dr. Smith's place, is now with the Red Cross and bacteriologist to the Blake Hospital, Paris. Colonel J. F. Siler, a member of the Robert M. Thompson Pellagra Commission of the Laboratory of Tropical Medicine, is in charge of the Laboratory Department of the Medical Corps, American Expeditionary Forces. The laboratories of the school are now under the charge of Victor C. Myers, Ph.D., professor of pathological chemistry. During the absence of members of the regular staff, Louise H. Meeker, M.D., is instructor in pathology, Adele E. Sheplar, M.D., instructor in bacteriology, and Anne G. Dellenbaugh, B.A., instructor in bacteriology.

Emma L. Wardell, M.S., has recently resigned as assistant in pathological chemistry to become assistant professor of household economics at the University of Illinois. John A. Killian, Ph.D., has been promoted to be associate in pathological chemistry. Owing to the emergencies of the war the board of directors is admitting women, who are graduates of recognized colleges, though not graduates in medicine, to courses in the laboratories. A number of such women have already been appointed to positions in the cantonment hospital laboratories. A new course in bacteriology begins on November 1.

SCIENTIFIC NOTES AND NEWS

Colonels James D. Glenman, William S. Thayer and John M. T. Finney have been promoted to be brigadier-generals in the Medical Corps.

To secure closer cooperation between American and British educational institutions, a mission headed by Dr. Arthur Everett Shipley, vice-chancellor of the University of Cambridge, has arrived in this country. In addition to Dr. Shipley, the zoologist, the mission includes two other men of science, Sir Henry Alexander Miers, formerly professor of mineralogy at Oxford, and Dr. John Joly, professor of geology and mineralogy in the University of Dublin.

Colonel Champe C. McCulloch, Jr., M.C., U. S. A., executive officer of the Board for Collecting and Preparing Material for a Medical and Surgical History of American Participation in the European War, has arrived in France, to establish his administration for this purpose. During his absence Lieutenant Colonel Casey A. Wood, M.C., U. S. A., will be in charge of this work in the Surgeon-General's Office.

Professor Frederic S. Lee, of Columbia University, has been sent to England and France on a special mission by the United States Public Health Service.

J. S. Jones has resigned as director and chemist of the Idaho station and professor of agricultural chemistry in the University of Idaho, and has assumed charge of the operating laboratory of one of the government nitrate plants under the Ordnance Division of the War Department.

Dr. Lorande L. Woodruff, professor of biology in Yale University, is serving as consulting physiologist in the Chemical Warfare Service, N. A.

William S. Bacon has been promoted to be a major in the Chemical Warfare Service and is now in command of the Lakehurst Proving Ground, Lakehurst, N. J.

Frank A. Waugh, head of the division of horticulture and professor of landscape gardening at the Massachusetts Agricultural College, is on leave of absence to fulfil his appointment to a captaincy in the Army Sanitary Corps.

Dr. H. K. Benson, director of the Bureau of Industrial Research, University of Washing-

ton, has been commissioned captain in the nitrate division of the Army Ordnance Department.

DR. J. M. LEWIS, associate professor of botany at the University of Texas, has been commissioned a captain in the Sanitary Corps and has reported at New Haven, Conn.

H. C. YOUNG, of the botanical department, Michigan Agricultural College, has been given indefinite leave of absence, having been appointed second lieutenant in the Sanitary Corps with headquarters for the present at the Yale Army Medical School.

E. R. KING, assistant professor of entomology at Cornell University, has been commissioned a second lieutenant in the Aviation Corps.

Ross A. BAKER, chief gas officer, Camp Pike, Ark., has been made officer in charge of gas training for Chief Gas Officers, Army Gas School, Humphreys, Va. Mr. Baker was formerly assistant professor in chemistry at the University of Minnesota.

OLAF P. JENKINS, assistant professor of economic geology of the State College of Washington, has been appointed geologist to the Arizona State Bureau of Mines, Tucson, Ariz. The first geological work to be done will be the preparation of a general geologic map of the entire state.

G. D. CAIN, chief chemist of the fertilizer control laboratory at the Louisiana Agricultural Station, has been appointed assistant director of the North Louisiana Station at Calhoun.

MR. ARTHUR LOWENSTEIN, for many years a fellow of the American Association for the Advancement of Science, formerly technical director of Morris and Co., and lately a consulting chemical engineer of Chicago, has recently been elected vice-president of Wilson and Co.

PROFESSOR JOHN WEINZIRL has returned to the University of Washington at Seattle, after spending a year's leave of absence in study at the Harvard Medical School, where he received the Dr.P.H. degree. He was also engaged in the food poisoning investigation directed by Dr. M. J. Rosenau, taking up the special problem of the microorganisms found in canned foods.

PROFESSOR H. C. H. CARPENTER, the president of the Institute of Metals, London, has been nominated to fill the office for a further year.

DR. H. S. HELE-SHAW and Signor Marconi have been elected honorary fellows of the Society of Engineers, London.

WE learn from *Nature* that Sir John Marshall, director-general of archeology in India, has, in consequence of illness, been granted leave of absence, during which his deputy will be Dr. Spooner, superintendent of archeology, Eastern Circle.

AT the request of the rector of the National University of Mexico, Dr. N. Leon, professor of anthropology, has been appointed the representative of Mexico in the Congress de Americanistas. which is to convene at Rio de Janeiro in June, 1919.

Nature states that the council of the South African Association for the Advancement of Science has resolved to institute a Sir David Gill memorial fund, to accumulate for a number of years until an amount has been raised adequate for some purpose to be decided upon. Mr. R. T. A. Innes, Union Observatory, Johannesburg, is the secretary and treasurer of the fund.

THE Training Camp for the Chemical Warfare Service, now under construction at Lakehurst, N. J., has been designated "Camp Kendrick," in honor of the late Colonel Henry L. Kendrick, who, after service as a commissioned officer, served as professor of chemistry, mineralogy and geology at the U. S. Military Academy from 1857 until his retirement from active service in 1880.

PROFESSOR DAVID ERNEST LANTZ, assistant biologist in the Biological Survey, United States Department of Agriculture, died of pneumonia on October 7, at his home in Washington, D. C. He was engaged chiefly in investigations of the economic relations of mammals and was the author of many reports and special papers on this subject.

Lieutenant Herbert Douglas Taylor, for three years an associate of the scientific staff of the Rockefeller Institute for Medical Research died on October 5, of pneumonia in his thirtieth year. Since America entered the war Lieutenant Taylor had devoted his time to the instruction of the United States Army surgeons for overseas service.

Walter W. Marshall, formerly instructor in zoology in the University of Minnesota, died at Camp Sherman, Ohio, on October 4, while attached to the Base Hospital.

Hamden Hill, research chemist of the Texas Oil Co., Bayonne, N. J., plant, died at St. Luke's hospital, New York City, on September 23, 1918, as the result of burns due to an explosion of gasoline vapors in the laboratory.

The death is announced of Dr. A. Mendoza, the pioneer of microphotography in Spain, chief of the laboratory of the Beneficencia provincial and of the scientific institute in charge of Professor Cajal.

Henry Suter, author of "A Manual of the New Zealand Mollusca," died in Christchurch, New Zealand, on August 1. A correspondent in New Zealand writes that he was born in Zurich Switzerland, in 1841, and went to New Zealand in 1886 to engage in farming, but soon relinquished the idea and devoted most of his time to studying the indigenous mollusca of the antipodean country. He contributed papers to the *Transactions of the New Zealand Institute*, the *Journal of the Malacological Society*, London, and other periodical publications. In 1913 he produced his "Manual," which was published for him by the New Zealand government. It contains the diagnoses of 1,079 species, 108 subspecies and 100 varieties of New Zealand molluscs. Two years later, the government published his atlas to the "Manual." This has 72 plates, containing many figures of molluscs from Mr. Suter's own drawings. In later years he gave special attention to Tertiary molluscs of New Zealand, and in 1916 the Geological Survey Department published as a bulletin a work by him on "The Tertiary Mollusca of New Zealand." His death leaves New Zealand without a recognized conchologist.

The first regular meeting of the New York Section of the American Chemical Society was held on October 11. Previous to the regular meeting a portrait of the late Charles M. Hall, presented to the Chemists' Club, was unveiled, and Mr. Arthur V. Davis, president of the Aluminum Company of America delivered an address. The regular meeting was devoted to the subject of the Bureau of Foreign and Domestic Commerce, Washington, D. C., and its relations to the business side of the American chemical industry, particularly to help us in gaining complete national chemical independence. C. D. Snow, assistant chief, Bureau of Foreign and Domestic Commerce; subject: "The ways in which the bureau aids American chemical business," with special consideration to German chemical business methods. C. P. Hopkins, editorial department, Bureau of Foreign and Domestic Commerce, subject: "Our publications and how they help chemical business," special consideration to foreign business. Dr. E. R. Pickrell, special agent, Bureau of Foreign and Domestic Commerce, subject: "How statistical information is obtained from import invoices." Special consideration to the forthcoming chemicals census.

Women chemists are needed by the government and also to stabilize the industries by replacing men chemists who have been called into service, according to Major F. E. Breithut, of the Chemical Warfare Service, U. S. A. This call is so urgent that he has asked the Women's Committee of the Council of National Defense to cooperate with the Army Medical Department in making a census of all the available women chemists in the country.

We learn from the *Experiment Station Record* that in connection with Idaho University a substation for the study of problems incident to high altitudes was authorized at the last session of the legislature. Action has been taken by the board of regents looking toward its establishment on state land at Felt, in Teton County, at an elevation of approximately 6,300 feet.

UNIVERSITY AND EDUCATIONAL NEWS

FIRMS in Manchester have offered to the College of Technology, Manchester, the sum of £3,000, spread over a period of five years, towards the cost of establishing a new department of industrial management.

ACCORDING to the *Journal of the American Medical Association* the conflict that has been going on in the University of Cordoba has grown more acute. The rector and several of the members of the faculties have presented their resignations. The head of the national government has appointed the minister of public instruction to take charge of the matter personally, and reorganize the staff of the university. At the request of the minister of public instruction, the medical faculty of the university of Buenos Aires did not appoint a new dean at the close of the term of office of Dr. Bazterrica, and this post is filled provisionally by the member of the university council who has been longest in office, Dr. E. Canton, until the reorganization of the university statutes has been sanctioned.

DR. WITHROW MORSE has been appointed professor of physiological chemistry in the medical school of the University of West Virginia, Morgantown.

DR. EUGENE L. PORTER, instructor in physiology at the Medical School of the University of Pennsylvania, has accepted the position of assistant professor of physiology at the Western Reserve University Medical school.

OWING to the death of Professor R. E. Sheldon and the resignation of several members of the staff, the department of anatomy, University of Pittsburgh has been reorganized. The present members of the instructing staff are Professor Robert Retzer, associate professor C. C. Macklin and Assistant Professor Harley N. Gould.

DISCUSSION AND CORRESPONDENCE

CORRELATION OF THE HYDROGEN-ION EXPONENT AND OCCURRENCE OF BACTERIA IN SOIL

IN an interesting note in SCIENCE (Vol. 48, pp. 139–140), followed by a fuller account in the *Journal of Agricultural Research* (Vol. 14, No. 7, pp. 265–271, 1918), Mr. P. L. Gainey has recently described experiments showing that the occurrence of *Azotobacter* in soils is controlled, apparently to a major extent, by the hydrogen-ion concentration, the limiting hydrogen-ion exponent being about 6.0. Previously to this, Christensen in Denmark had described some experiments on this general subject,[1] besides those reviewed by Gainey.

Christensen mentions having applied the *Azotobacter* test and the litmus paper test together to about 40,000 soil specimens. He found a general correlation between acidity to litmus and absence of *Azotobacter*. He also found a close correlation between the *Azotobacter* test and a para-nitrophenol test: "In the case of soils showing a neutral reaction for litmus, there is a distinct difference between the two groups,—with and without *Azotobacter* vegetation,—for the former colors the liquid (para-nitrophenol) somewhat more yellow than the latter." In applying para-nitrophenol, a solution of it was mixed with the soil, and the soil particles allowed to settle out over night.

There is considerable objection against mixing the indicator with the soil mass, and especially in the case of a one-colored indicator like para-nitrophenol, for any loss of indicator due to absorption by the soil mass would not be distinguishable from an actual color discharge due to acidity. The procedure of Christensen has been checked only by means of the litmus paper and the *Azotobacter* test itself. If the absorption of indicator is not serious, the results of Christensen can be interpreted in terms of hydrogen-ion exponent and are then in accord with the results of Gainey, for the turning point of para-nitrophenol is about 6.

The procedure used by Gainey, on the other hand, is the one used by the writer in 1916, tested by means of electrometric measurements of the soil suspension, and found to give at least approximately correct results.[2]

[1] *Soil Science*, Vol. 4, pp. 115–178, 1917.

[2] *Jour. Wash. Acad. Sci.*, Vol. 6, pp. 7–16, 1916.

The procedure involves the use of brilliant two-colored indicators, such as those recommended by Clark and Lubs, applied to soil extracts obtained without filtration by the use of a centrifuge.

In work being published elsewhere, L. A. Hurst and the writer have compared the electrometric method with the improved colorimetric method as described by Clark and Lubs[3] and have found a very close agreement in the results of the two methods applied to soils. We have found it advisable for soil work to use the phenol-sulfon-phthalein indicators in water solution as the monosodium salts, and to use (pure) methyl red, without neutralization, in alcoholic solution.

In previous papers from this laboratory the suggestion has been made that the occurrence of the common potato scab may be limited by the hydrogen-ion concentration of the soil.[4] In the work mentioned above this seems to have been demonstrated.

There have been located now two points of interest on the scale of hydrogen-ion exponents for soils: (about) 6.0, the acid limit for *Azotobacter,* and (about) 5.2, the acid limit for the potato-scab organism. In addition to these organisms, other important soil organisms have been studied in their relation to hydrogen-ion exponent in culture media.[5] In general, such pure culture studies should be supplemented with soil studies, for a number of reasons, one of which is that strains of unusual resistance to acidity might be missed in the study of a limited number of strains in pure culture.

From the considerable quantity of work done some years ago in culture media, it was to be expected that limits of hydrogen-ion concentration should be discoverable for the growth and survival of microorganisms in soil, providing only that the soil has a definite and significant hydrogen-ion concentration. That the soil has definite and biologically significant hydrogen-ion concentration has been demonstrated by the work of this laboratory. The expectation may be different with regard to the growth of crops, since (1) very little work involving real control of hydrogen-ion concentration has been done on this subject,[6] and (2) the welfare of crops may depend in some cases on the success of *Azotobacter,* of legume bacteria, or of other microorganisms less resistant to acidity than the plant itself. We do not yet know whether, for instance, a point can be located, in acid soils not altogether infertile, beyond which acidity the growth of red clover is always more or less unsatisfactory; we have seen, however, some indications that such a point may exist at about the exponent 5.

L. J. Gillespie
Bureau of Plant Industry,
Washington, D. C.

[3] *Jour. Bact.,* Vol. 2, Nos. 1, 2, 3, 1917.

[4] Gillespie and Hurst, *Soil Science,* Vol. 4, pp. 313–319, 1917, and Gillespie, *Phytopathology,* Vol. 8, pp. 257–269, 1918.

[5] *E. g.,* E. B. Fred, *Abstracts of Bacteriology,* Vol. 2, pp. 10–11, 1918.

[6] See Hoagland, *Soil Science,* Vol. 3, pp. 547–560, 1917, who studied the barley plant.

THE NEED OF ANOTHER PHILANTHROPIST BY ORGANIC CHEMISTS

Wanted, available sets of the greatest of all reference books in organic chemistry, Beilstein's "Handbuch der Organischen Chemie," for the immediate use of organic chemists in the numerous governmental and industrial laboratories. Why? Because these chemists have been laboring under a serious handicap for the past four years, especially in the preparation of war chemicals and explosives, medicinals, and dyestuffs. How can this pressing need be met? In a timely editorial in the September number of *The Journal of Industrial and Engineering Chemistry* Dr. Charles H. Herty has shown that photographic methods are available for the reproduction of this valuable work at a comparatively low cost. Who is to finance the preparation of the zinc etchings? There is probably some man of wealth who can appreciate the present need of the organic chemist and come to the rescue. The need is urgent. It should be met and met immediately.

The first appeal[1] for financial assistance in

[1] Science, N. S., Vol. XLVII., pp. 225–228 and pp. 590–591.

the preparation of rare and difficult organic chemicals has brought about the establishment of a source of supply of organic reagents for research in colleges and universities and for industrial purposes. This was met by an industrial establishment[2] which set apart a separate section of its laboratory for this purpose.

It seems to me that the present emergency is still more urgent. A tremendous amount of time is lost by the chemist in looking through the literature in the libraries for the details of preparation and properties of known organic compounds. Beilstein's "Handbuch" is a compilation of all the organic chemicals existing at the time of its publication. The need of available sets of this standard work of reference is self evident.

To quote the editorial in part:

> We would suggest and urge a reprinting of Beilstein under conditions which would make it available quickly to all organic chemists. To do this through the ordinary process of linotyping and proof-reading would be impracticable because of the present shortage of labor and the lack of knowledge of German on the part of linotypists and proof-readers accustomed to chemical literature. Fortunately, photographic methods are available, requiring a minimum of labor and insuring speed and absolute accuracy of reproduction.
>
> To make the proposition definite we have obtained prices for zinc etchings from one of the largest engraving houses of New York City. For the 11,126 pages of Beilstein the cost of zinc etchings at standard prices would be $30,040.20. For paper and press work (calculating on the quality of paper and charges for press work in publishing this journal), $6,119.30 would be required for one thousand sets, making a total of $36,159.50. Allowing for constantly advancing prices, and for royalty charges, $40,000 should safely cover the entire costs, not including binding, of course.
>
> Do we feel any qualms of patriotic conscience about such a reproduction? Well, we should worry! Germans are daily profiting in the conduct of the war through the utilization of American inventions, the submarine, the telegraph, the telephone, the machine gun and what not. Let some one donate $30,000 and let the sets be sold at $10 each (the ordinary cost is $100) so that every organic chemist could have one right at his hand, then—let the Germans worry.

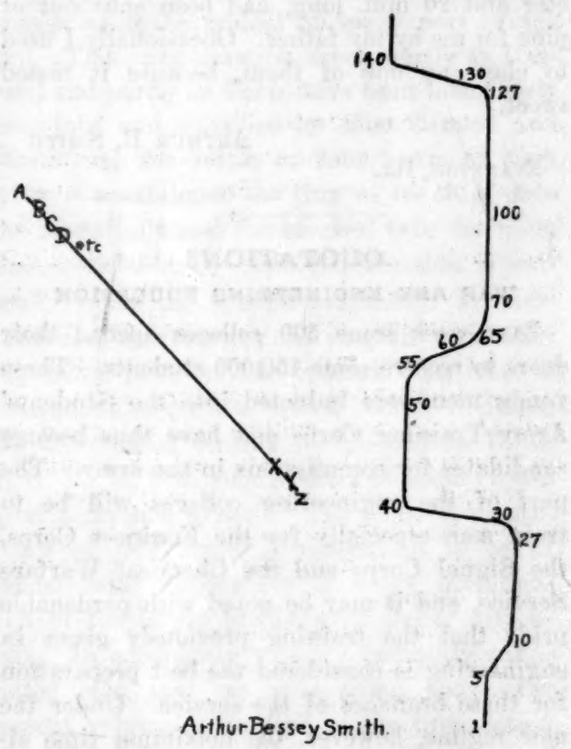
A donation for this worthy cause would be a lasting memorial to any man, and would place him among the great benefactors to the science of chemistry. Who is the philanthropist that will *immediately* set the zinc to etching?

CLARENCE AUSTIN MORROW
DIVISION OF AGRICULTURAL BIOCHEMISTRY,
UNIVERSITY OF MINNESOTA

[2] SCIENCE, N. S., Vol. XLVII., pp. 91–92.

COLOR ASSOCIATION

TO THE EDITOR OF SCIENCE: The letter from David Starr Jordan[1] called to my attention a fact which I did not know before. On mentioning it to my laboratory assistant, Mr. Herbert Edward Clapham, he said that he, too,



associated colors with the letters of the alphabet, but not with all, and that figures were also associated with colors. At my request he wrote out the following list.

A gray	O black	1 white
B light red	P brown	2 red
C black	Q — — —	3 light red
D pink	R — — —	4 gray

[1] SCIENCE, September 28, 1917, pp. 311–312.

E scarlet	S white	5 white
F pink	T red	6 white
G — — —	U golden brown	7 golden
H yellow	V gray	8 brown
I white	W — — —	9 red
J white	X — — —	0 black
K — — —	Y white	
L — — —	Z red	
M olive green		
N olive green		

Although I have never associated colors with letters or figures, from my earliest recollection I have always thought of letters and of figures arranged in the relative positions shown on page 395. The origin of this I do not know. It might have been something in the presentation of these things by my first teacher, or the manner in which little wooden sticks were laid out on my desk in the first number work. These little sticks, each about 3 mm. in diameter and 20 mm. long, had been split out of pine for me by my father. Occasionally I used to chew up one of them, because it tasted sweet.

Arthur B. Smith

Evanston, Ill.

QUOTATIONS

WAR AND ENGINEERING EDUCATION

Last week some 500 colleges opened their doors to receive some 150,000 students. These young men were inducted into the Students' Army Training Corps and have thus become candidates for commissions in the army. The part of the engineering colleges will be to train men especially for the Engineer Corps, the Signal Corps and the Chemical Warfare Service, and it may be noted with pardonable pride that the training previously given in engineering is considered the best preparation for these branches of the service. Under the new regime, however, the maximum time allowed for the full engineering course is two years, including work in the summer quarters, and the further training of men with advanced standing will be curtailed accordingly. Each college will be expected to outline its courses much on its own initiative, especially for men who have already spent a year or more in that institution.

At this stage of the development of engineering education for war we are reminded of the work done by teachers in the engineering colleges beginning a year ago last May, when they were asked on about two weeks' notice to prepare to receive men for training in military aeronautics. While the lecture material and laboratory apparatus were collected and arranged under difficult circumstances, the officers in responsible charge in Washington were enabled to choose the best methods developed in the six different schools and thus quickly arrange a satisfactory training course. It is to be hoped, however, that the engineering colleges will not follow in the footsteps of the aviation schools in at least two respects. It seems undesirable to put civilian instructors in uniform and certainly a mistake to have them decorated with brevet officers' bars. An instructor with any character should have no trouble in gaining the respect of his classes in this serious undertaking. Again, in the matter of standardization we trust the engineering colleges will not make animated phonographs of their teachers.

It is quite evident that the War Department has outlined an excellent device for producing a high grade of men to lead the army. Those who are left behind in their college work are transferred to army cantonments, while those who complete their college courses with credit are sent to officers' training camps and there must prove their ability to handle men before they receive commissions. Only the most capable men will survive such tests.

While we are thus assured that the primary purpose of developing a high class of officers will be attained, it is interesting to speculate upon the effect of this intensive training on engineering education. Much of the preliminary work in mathematics, languages and science will be eliminated or curtailed, and we shall have an opportunity to view the results of this system of education, provided that the war lasts several years. On the one hand, it is doubtful if these men will have the training which will probably be required for meeting the tremendous problems of reconstruction. It would seem desirable, therefore, to encourage them to complete their engineering prepara-

tion after the war, and the plan of giving credit for the intensive war courses toward a degree in engineering should be adopted. On the other hand, it is reasonably certain that the character of the men who complete the new engineering courses will be excellent, and the colleges should insist upon this high standard of scholarship and character after the war.—*The Electrical World.*

SCIENTIFIC BOOKS

Annals of the Astronomical Observatory of Harvard College. Vol. 79, Part 1. 4°, pp. 86; Vol. 83, Part 2, 4°, pp. 28; Vol. 91, 4°, pp. 290. Edward C. Pickering, Director. Cambridge, Mass. 1918.

The *Annals of the Harvard College Observatory* occupy a unique position in the literature of astronomy by reason of their great extent and the wide range of subject matter included in them. Collectively they form an impressive memorial to the indefatigable director who has inspired the production and publication of more than three fourths of the four score volumes composing the series. In diversity of subject matter, in successful coordination of effort and in condensed presentation of material the three volumes briefly cited above are typical of the institution from which they come.

The first of the three, prepared by Leon Campbell, contains observations of three hundred and twenty-three variable stars made during the years 1911-16, in continuation of a program commenced twenty-two years earlier. In accordance with the general policy of the observatory its purpose is the accumulation and preservation of reliable data for future study of the changes in the amount of light received from stars of the class designated variables of long period. These changes of brilliancy are notoriously irregular in character and our knowledge of the causes upon which they depend is only fragmentary. The relation between these causes and the data furnished by the present volume is committed to the future investigator.

The second volume cited, prepared under the direction of Alexander McAdie, lies in the very different field of meteorology and contains observations made at Blue Hill Observatory (Mass.) in the year 1917. Apart from a brief preface the work is wholly tabular in character and contains both in detail and in summarized form the customary meteorological data.

The last of the volumes named above, prepared jointly by Annie J. Cannon and Edward C. Pickering is an initial installment of the Henry Draper Catalogue of Stellar Spectra, to be completed in seven more similar volumes. For the most part its pages are tabular in character and are intended to place at the disposal of the theorist, data as accurate and as extensive as can be derived from the great store of Harvard photographs of stellar spectra, relative to the spectrum and magnitude of a great number of stars, so chosen as to be typical of every part of the sky. These photographs, taken partly at Harvard and partly in Peru, have been laboriously examined and classified by Miss Cannon and others and the result of four years of such labor is a catalogue showing as its chief data the magnitude and the spectral type for more than 200,000 stars. The classification is naturally upon the system originated at Harvard and now in general use, in which for the most part, stellar spectra constitute a continuous sequence whose chief divisions are represented serially by the letters B, A, F, G, K, M, with subdivisions of these classes upon a decimal system. The physical significance of this series is recognized to be of fundamental importance in every investigation of the larger problems of stellar astronomy. In accordance with its distinctly enunciated plan that we have noted above, the present volume is devoted to the preparation of material out of which the implications of this series may be worked more perfectly than has yet been done. As a contribution to that end the introduction to the volume contains explicit definition and illustration of each spectral class and of many of their subdivisions, presented in brief but very convenient form.

The three volumes are worthy additions to a long line of predecessors whose characteris-

tics have become so well determined and so familiar that if title pages were removed and all reference to the authors deleted, no astronomer could be left in doubt as to the source from which they came.

George C. Comstock
University of Wisconsin

The Chemistry of Food and Nutrition. By Henry C. Sherman. Second edition. New York, The Macmillian Co. 1918.

This well-known text-book has been rewritten and presents modern knowledge upon the subject of nutrition in an exceptionally clear and readable form. The chemistry of foods is described, then the digestion and metabolism of the different food-stuffs. The review of the subject of the "vitamines" and of "growth hormones" is excellently handled and nowhere have these "accessory factors" in nutrition been more clearly defined. Sherman's long experimental studies of the salt metabolism and especially the calcium metabolism give authority to his discussion of the inorganic food-stuffs. The chapter on the dietary standards and economic use of food is of an order of excellence which has never been surpassed. Sherman's experience, based upon his own painstaking researches into the dietary habits of the poor classes of New York City, conducted for the New York Association for Improving the Condition of the Poor, leads him to declare that "the most frequent deficiency in American dietaries is inadequacy of the total food or energy value and most dietaries actually observed are of such composition as would furnish enough of each essential element if the total amount of food eaten were sufficient to provide a liberal energy supply."

Sherman clearly sets forth the principles of a sufficient and economical dietary in such a manner as to bring to mind the really great progress in the science of dietetics which has taken place in the last decade. This excellent and thoroughly scientific treatise upon nutrition should be in the hands of all who are interested in the food question, both as it appears now and as it will shape itself after the war. It is a pleasure to note that the author has been unusually conscientious and generous in giving credit to the work of others.

Graham Lusk

SPECIAL ARTICLES

THE FORMATION OF THE FAT DROPLETS IN THE CELLS OF TISSUE CULTURES

Experiments of Daddi (1896)[1] and more particularly those of Riddle (1910)[2] show that Sudan III., fed to animals, is taken up by fat in the intestine, passes through the intestinal wall in combination with fat, and is deposited in the body cells in the form of red fat globules. These observations suggested a method for testing out the question as to whether or not the mitochondria form the fat droplets. If Sudan III. remains attached to the fat, as Riddle seems convinced it does, and the cells store up this Sudan III. fat, the question arises, is the Sudan III. fat deposited in the mitochrondria before appearing as red fat globules in the cytoplasm? If such were the case, we should be able to find traces of the Sudan III. in the mitochondrium, at least during the final stages in the formation of the fat droplet, but this could not be done, and as will be seen below, the mitochondria take no part in the formation of the fat droplet under such conditions.

The yolk of a hen egg was mixed with Sudan III. until it became red. A small quantity of this red yolk was then diluted with Locke-Lewis solution and placed on a number of twenty-four-hour cultures of 6–9-day chick embryos (Lewis and Lewis method). Certain of the cells were then selected and their unstained fat droplets noted and drawn. Each of these cells was carefully followed for the next few hours, or until a number of fat droplets had appeared in the cytoplasm. These took the form of exceedingly small, reddish-yellow droplets, often far removed from any

[1] Daddi, L., "Nouvelle méthode pour colorer la graisse dans les tissues," *Arch. Ital. de Biol.*, 26, 1896.

[2] Riddle, O., "Studies with Sudan III. in Metabolism and Inheritance," *Jour. Exper. Zool.*, 8, 1910.

mitochondrium. The mitochondria at no time contained any orange-colored droplets or any droplets at all. Neither did they become rounded, loop- or ring-shaped. As a matter of fact, they behaved in a manner quite like what has been described as normal for the cells of tissue cultures (Lewis and Lewis, 1915).[3] Once a loop-shaped mitochondrium was seen, but this unbent and became a thread again without the formation of any globule. The very small orange-colored droplets unite into larger ones, others appear in the cell, and thus in the course of five or six hours several additional fat droplets of different sizes can be seen. While this process is going on, the fat droplets previously noted and drawn take on a bright orange stain, so that in a very short time it is impossible to distinguish by means of color those droplets which were present in the cell before the addition of the Sudan III. yolk. The color exhibited by the fat droplet in the living cell, while a bright yellowish-red, was never the same shade as that obtained in a culture fixed and stained with Sudan III. Nile blue sulphate could not be used in these experiments because as has been previously shown, it stains bodies that are not fat in the living cell. The fat droplets of the mesenchyme cells remain distinctly smaller than those of the clasmatocyte. Neither the mesenchyme cell nor the clasmatocyte were ever observed in the process of engulfing a yolk globule. It is doubtful whether either type of cell ingests fat in tissue cultures.

Certain of the cultures, which when living contained no loop- or ring-shaped mitochondria, after the application of different fixatives contained in varying numbers swollen, varicose and ring-shaped mitochondria according to the method of fixation employed. The question of fixation is necessarily quite different in these cultures, since most of the cells are spread out in a thin layer unprotected even by plasma from the direct action of any chemical placed upon them. Nevertheless since certain forms of mitochrondria were shown in these cultures to be the result of the method of preservation, it would certainly seem probable that these same shapes observed by other investigators (Dubreuil, 1911[4] Guilliermond, 1913),[5] were obtained in the same manner.

In the above observations there was no need to resort to fixed preparations, as all the structures of the cell were clearly seen, and the bright orange-colored droplets could be followed without fear of confusing them with the easily distinguishable mitochondria. The fat droplets accumulated in the living cell without being associated at any time with the mitochondria and without any changes taking place in the shape of the mitochondria such as have been claimed by other observers (Dubreuil 1911,[4] Russo 1910,[6] etc.).

MARGARET REED LEWIS

[3] Lewis, M. R., and Lewis, W. H., "Mitochondria and other Cytoplasmic Structures in Tissue Cultures," *Amer. Jour. of Anat.*, 17, 1915.

[4] Dubreuil, G., "Les nitrochondries des cellules-adi peuses," *Compt. rend. Soc. Biol.*, 1911.

[5] Guilliermond, A., "Sur les nitrochrondries des champignons," *Compt. rend. Soc. de Biol.*, 1913.

[6] Russo, A., "Sui mutamenti che subiscono i mitochondri ed i materiali dentoplasmici dell oocite di coniglia in diversi periodi di inanizione," *Arch. f. Zellf.*, 4–5, 1910.

THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-fifth summer meeting of the society was held, by invitation, at Dartmouth College, Hanover, N. H., on Wednesday, Thursday and Friday, September 4–6, 1918, connecting with the meeting of the Mathematical Association of America, which began on Friday morning. The joint dinner of the two organizations, on Thursday evening, was attended by fifty-six members and friends, who were greeted by Dean Laycock in the name of the College. At the joint session on Friday morning Professor A. G. Webster gave an address on "Mathematics of warfare."

The college dormitories were opened for the accommodation of the visitors, and meals were served in the commons. Headquarters and general gathering place between the sessions was provided in College Hall, where an informal reception was held on Wednesday evening. A letter of welcome from Business

Director Keyes tendered the hospitality of the college to the two societies. Excursions into the country about Hanover were arranged for the closing days of the meetings. At the joint session a vote of thanks was extended to the college authorities for their generous cooperation toward a successful occasion.

The meeting of the society included an evening session on Wednesday and the usual morning and afternoon sessions on Thursday, besides the joint session on Friday morning. The attendance included forty-six members. Professor W. W. Johnson presided at the Wednesday session, and Professor H. W. Tyler at the Thursday sessions. The following new members were elected: Professor A. L. Candy, University of Nebraska; Mr. J. R. Carson and Mr. R. S. Hoyt, American Telephone and Telegraph Company; Dr. K. W. Lamson, Columbia University; Professor A. S. Merrill, University of Montana; Mr. F. H. Murray, Harvard University; Mr. H. W. Nichols, Western Electric Company; Professor W. E. Patten, Government Institute of Technology, Shanghai, China. Nine applications for membership were received.

The following papers were read at this meeting:

L. B. Robinson: "A curious system of polynomials."

G. A. Miller: "Groups generated by two operators whose relative transforms are equal to each other."

P. J. Daniell: "Differentiation with respect to a function of limited variation."

B. F. Groat: "Models and hydraulic similarity."

L. C. Mathewson: "On the groups of isomorphisms of a system of abelian groups of order p^m and type $(n, 1, 1, \ldots, 1)$."

C. N. Reynolds: "On the zeros of solutions of linear differential equations of the fourth order."

J. E. Rowe: "Related invariants of two rational sextics."

W. W. Johnson: "The nature and history of Napier's rules of circular parts."

O. E. Glenn: "On a new treatment of theorems of finiteness."

Louise D. Cummings: "The trains for the 36 groupless triads on 15 elements.

Josephine R. Roe: "Interfunctional expressibility problems of symmetric functions (third paper)."

B. F. Groat: "Equations of the elastic catenary."

C. H. Forsyth: "Relative distributions."

W. D. Cairns: "A derivation of the equation of the normal probability curve."

Mary F. Curtis: "Curves invariant under point transformations of special type."

G. D. Birkhoff: "On stability in dynamics."

Daniel Buchanan: "Periodic orbits on a surface of revolution."

A. R. Schweitzer: "On the iterative properties of an abstract group (third paper)."

C. N. Haskins: "On the roots of the function $P(x)$ associated with the gamma function" (preliminary communication).

Christine Ladd-Franklin: "Bertrand Russell and symbol logic."

Abstracts of the papers will appear in the secretary's report in the November *Bulletin*.

The next regular meeting of the society will be held at Columbia University on Saturday, October 26.

The society has recently published Part I. of Volume V. of its series of Colloquium Lectures being the lectures given by Griffith C. Evans on "Functionals and their applications: selected topics, including integral equations" at the Cambridge Colloquium, 1916.

F. N. Cole,
Secretary

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